What is claimed is:

1. A method for fabrication of a magnetic tunneling junction (MTJ) device, comprising:

depositing a multi-layered structure over a substrate, said multi-layered structure comprising a buffer layer, a seed layer, an antiferromagnetic layer, a pinned layer, a barrier layer, a free layer, and a passivation layer; and,

annealing said multi-layered structure under conditions determined to simultaneously optimize a plurality of performance parameters of said MTJ device.

2. The method of claim 1, wherein said barrier layer is characterized by a substantially amorphous structure with little or no crystallinity.

3. The method of claim 1, wherein said antiferromagnetic layer is comprised of FeMn.

4. The method of claim 1, wherein said antiferromagnetic layer is comprised of PtMn.

5. The method of claim 1, wherein said antiferromagnetic layer is comprised of IrMn.

6. The method of claim 1, wherein said conditions are comprised of temperature and magnetic field.

7. The method of claim 1, wherein said step of depositing occurs at room temperature.

8. The method of claim 1, wherein said plurality of performance parameters comprise magnetoresistance.

9. The method of claim 1, wherein said plurality of performance parameters comprise electrical resistance.

10. The method of claim 1, wherein said plurality of performance parameters comprise magnetic field sensitivity.

11. The method of claim 1, wherein said plurality of performance parameters comprise magnetic noise.

12. The method of claim 1, wherein said buffer layer is comprised of Pt, the seed layer is comprised of $Ni_{81}Fe_{19}$, the antiferromagnetic layer is comprised of $Fe_{50}Mn_{50}$, the pinned layer is comprised of $Ni_{81}Fe_{19}$, the barrier layer is comprised of Al_2O_3, the free layer is comprised of $Ni_{81}Fe_{19}$.

13. The method of claim 12, wherein said buffer layer has a thickness of about 30 nm.

14. The method of claim 12, wherein said seed layer has a thickness of about 3 nm.

15. The method of claim 12, wherein said antiferromagnetic layer has a thickness of about 13 nm.

16. The method of claim 12, wherein said pinned layer has a thickness of about 6 nm.

17. The method of claim 12, wherein said barrier layer has a thickness of about 0.5 nm to about 2 nm, said barrier layer being characterized by a substantially amorphous structure with little or no crystallinity.

18. The method of claim 12, wherein said free layer has a thickness of about 12 nm.

19. The method of claim 12, wherein said annealing occurs at a temperature of between about 168°C to about 170°C.

20. The method of claim 12, wherein said annealing occurs for about ten minutes.

21. The method of claim 12, wherein said annealing occurs in an external DC field of about 1.6 kOe.

22. A magnetic tunneling junction (MTJ) device, fabricated by the method comprising:

depositing a multi-layered structure over a substrate said multi-layered structure comprising a buffer layer, a seed layer, an antiferromagnetic layer comprised of FeMn, a pinned layer, a barrier layer, a free layer, and a passivation layer;

annealing said multi-layered structure at a temperature between about 168°C to about 170°C.

23. The magnetic tunneling junction device of claim 22, wherein said buffer layer is comprised of Pt.

24. The magnetic tunneling junction device of claim 22, wherein said seed layer is comprised of $Ni_{81}Fe_{19}$.

25. The magnetic tunneling junction device of claim 22, wherein said pinned layer is comprised of $Ni_{81}Fe_{19}$.

26. The magnetic tunneling junction device of claim 22, wherein said barrier layer is comprised of Al_2O_3.

27. The magnetic tunneling junction device of claim 22, wherein said the free layer is comprised of $Ni_{81}Fe_{19}$.

28. The magnetic tunneling junction device of claim 22, wherein said buffer layer has a thickness of about 30 nm.

29. The magnetic tunneling junction device of claim 22, wherein said seed layer has a thickness of about 3 nm.

30. The magnetic tunneling junction device of claim 22, wherein said antiferromagnetic layer has a thickness of about 13 nm.

31. The magnetic tunneling junction device of claim 22, wherein said pinned layer has a thickness of about 6 nm.

32. The magnetic tunneling junction device of claim 22, wherein said barrier layer has a thickness of about 0.5 nm to about 2 nm, said barrier layer being characterized by a substantially amorphous structure with little or no crystallinity.

33. The magnetic tunneling junction device of claim 22, wherein said free layer has a thickness of about 12 nm.

34. The magnetic tunneling junction device of claim 22, wherein said barrier layer is formed by oxidizing a layer of Al in radio frequency O_2 glow discharge.

35. The magnetic tunneling junction device of claim 22, wherein said free layer is deposited in a substantially oxygen free environment.

36. The magnetic tunneling junction device of claim 22, characterized by a sensitivity of up to about 6%/Oe.

37. The magnetic tunneling junction device of claim 22, capable of producing an antiferromagnet/ferromagnet exchange bias of up to about 420 Oe.

38. The magnetic tunneling junction device of claim 22, whereby magnetic noise is reduced to about 1 $nT/Hz^{1/2}$.

39. The magnetic tunneling junction device of claim 22, characterized by a magnetoresistance ratio of up to about 38%.

40. The magnetic tunneling junction device of claim 22 comprising a part of a sensor device.

41. The magnetic tunneling junction device of claim 22 comprising a part of a memory device.

42. A magnetic tunneling junction device, fabricated by the method comprising:

depositing a multi-layered structure over a substrate said multi-layered structure comprising a buffer layer, a seed layer, an antiferromagnetic layer comprised of PtMn, a pinned layer, a barrier layer, a free layer, and a passivation layer;

annealing said multi-layered structure under conditions determined to simultaneously optimize at least the magnetoresistance, electrical resistance, sensitivity and magnetic noise.

43. A magnetic tunneling junction device, fabricated by the method comprising:

depositing a multi-layered structure over a substrate said multi-layered structure comprising a buffer layer, a seed layer, an antiferromagnetic layer comprised of IrMn, a pinned layer, a barrier layer, a free layer, and a passivation layer;

annealing said multi-layered structure under conditions determined to simultaneously optimize at least the magnetoresistance, electrical resistance, sensitivity and magnetic noise.